OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **HILLS POND** the program coordinators recommend the following actions. *Please note, these observations are based on a limited set of data. With only one sample session per year it is difficult to construct accurate trend analyses.*

FIGURE INTERPRETATION

- Figure 1: These graphs illustrate concentrations of chlorophyll-a in the water column. Algae are microscopic plants that are a natural part of lake ecosystems. Algae contain chlorophyll-a, a pigment necessary for photosynthesis. A measure of chlorophyll-a can indicate the abundance of algae in a lake. The historical data (the bottom graph) show a *stable* in-lake chlorophyll-a trend. Algal abundance in August was slightly higher this year. The increase in rain this season might have caused an increase in the amount of nutrients entering the lake, which can help algae to grow. Chlorophyll-a concentrations for Hills Pond were below the NH average once again! While algae are present in all lakes, an excess amount of any type is not welcomed. Concentrations can increase when there are external and internal sources of phosphorus, which is the nutrient algae depend upon for growth. It's important to continue the education process and keep residents aware of the sources of phosphorus and how it influences lake quality.

- Figure 2: Water clarity is measured by using a Secchi disk. Clarity, or transparency, can be influenced by such things as algae, sediments from erosion, and natural colors of the water. The graphs on this page show historical and current year data. The lower graph shows a *stable* trend in lake transparency. The slight increase in algal abundance likely caused the decrease in transparency seen in August. This year's reading was below the state mean and was the lowest ever recorded since Hills Pond joined VLAP. The 2000 sampling season was considered to be wet and, therefore, average transparency readings are expected to be slightly lower than last year's readings. Higher amounts of rainfall usually cause more eroding of sediments into the lake and streams, thus decreasing clarity.

- Figure 3: These figures show the amounts of phosphorus in the epilimnion (the upper layer in the lake) and the hypolimnion (the

lower layer); the inset graphs show current year data. Phosphorus is the limiting nutrient for plants and algae in New Hampshire waters. Too much phosphorus in a lake can lead to increases in plant growth over time. These graphs show a *fairly stable, yet seasonally variable,* trend for in-lake phosphorus levels. Monthly samples would help us to determine the trends more easily. The August phosphorus concentrations were above those recorded last season, which could account for the increased algal growth. Phosphorus concentrations remained below the NH median line this season. One of the most important approaches to reducing phosphorus levels is educating the public. Humans introduce phosphorus to lakes by several means: fertilizing lawns, septic system failures, and detergents containing phosphates are just a few. Keeping the public aware of ways to reduce the input of phosphorus to lakes means less productivity in the lake. Contact the VLAP coordinator for tips on educating your lake residents or for ideas on testing your watershed for phosphorus inputs.

OTHER COMMENTS

- Conductivity in the South Inlet was back to normal levels this season (Table 6). The increased rainfall helped to flush the inlet out, which decreased the accumulation of pollutants. This decrease is a positive sign for the Inlet since conductivity increases often indicate the influence of human activities on surface waters. Septic system leachate, agricultural runoff, iron deposits, and road runoff can each influence conductivity readings.

- The upstream phosphorus concentration for East Inlet was slightly higher than the downstream site this season (Table 8), however phosphorus concentrations in the downstream site were decreased from the 1999 result. This Inlet is on the side of the lake that is heavily developed, and therefore human impact is greater. The decrease in the downstream site is actually a positive sign since phosphorus is being diluted before entering the lake. However, this could indicate that the source of phosphorus to the inlet is greater upstream, and therefore limiting or eliminating this source would be even more beneficial to the pond. Some sources of phosphorus to NH lakes are fertilizers, detergents, septic system leachate, road construction, and runoff.

- Bacteria concentrations at the beach were very low in August (Table 12), and not above the state standard of 88 counts per 100 mL set for public bathing places or the standard of 406 counts per 100 mL for Class B Surface waters. Monitors may wish to repeat this test on a weekend when beach use is heavy. Because bacteria die quickly in cool pond waters, testing is most accurate and most representative of health risk to bathers when the source (humans, or perhaps waterfowl) is present.

- *We would like to encourage the association or volunteers to conduct more sampling events in the future. With a limited amount of data it is difficult to determine water quality trends. Since weather patterns and activity in the watershed can change throughout the summer it is a good idea to sample the lake several times over the course of the season.*

USEFUL RESOURCES

A Guide to Developing and Re-Developing Shoreland Property in New Hampshire: A Blueprint to Help You Live By the Water. North Country RC&D, 1994. (603) 527-2093.

Save Our Streams Handbook for Wetlands Conservation and Sustainability. (800) BUG-IWLA, or visit www.iwla.org

Septic Systems and Your Lake's Water Quality, WD-BB-11, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Effects of Phosphorus on New Hampshire's Lakes, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

The Wetlands Resource, WD-WB-7, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Bacteria in Surface Waters, WD-BB-14, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Proper Lawn Care Can Protect Waters, WD-BB-31, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

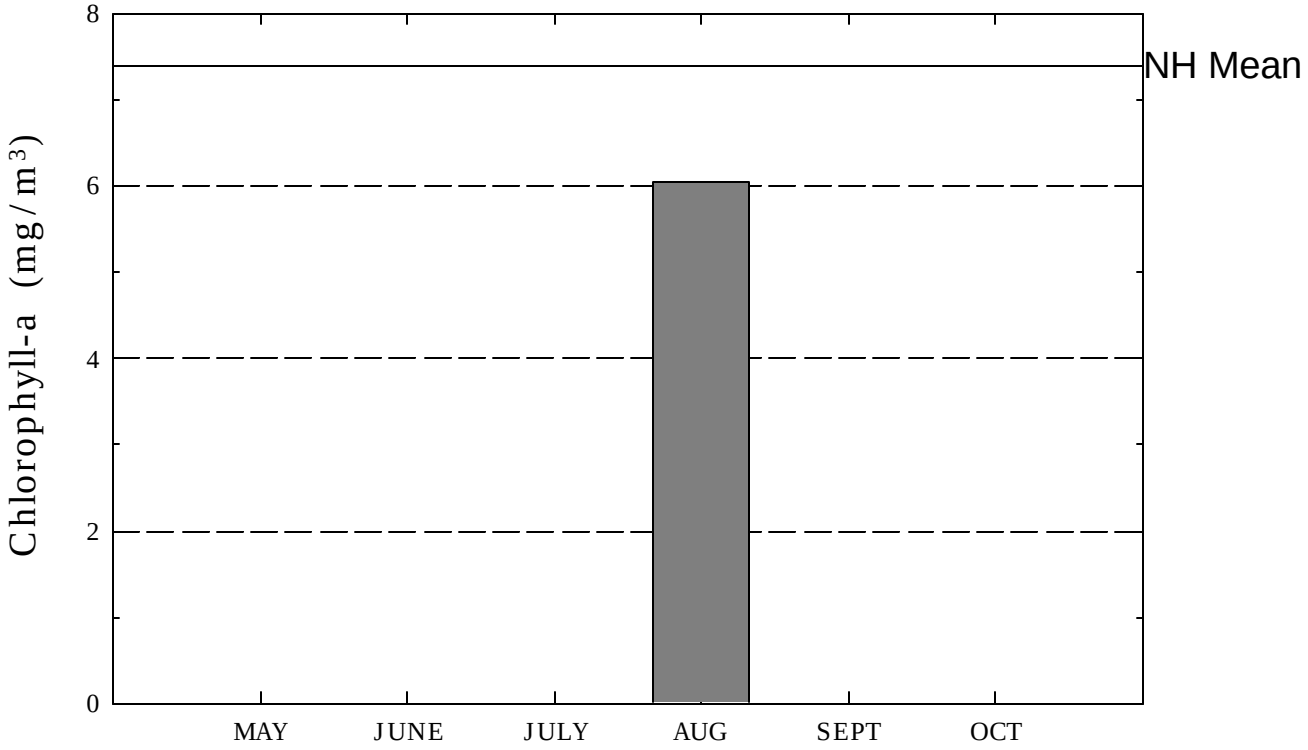
The Watershed Guide to Cleaner Rivers, Lakes, and Streams, Connecticut River Joint Commissions, 1995. (603) 826-4800

Through the Looking Glass: A Field Guide to Aquatic Plants. North American Lake Management Society, 1988. (608) 233-2836 or www.nalms.org

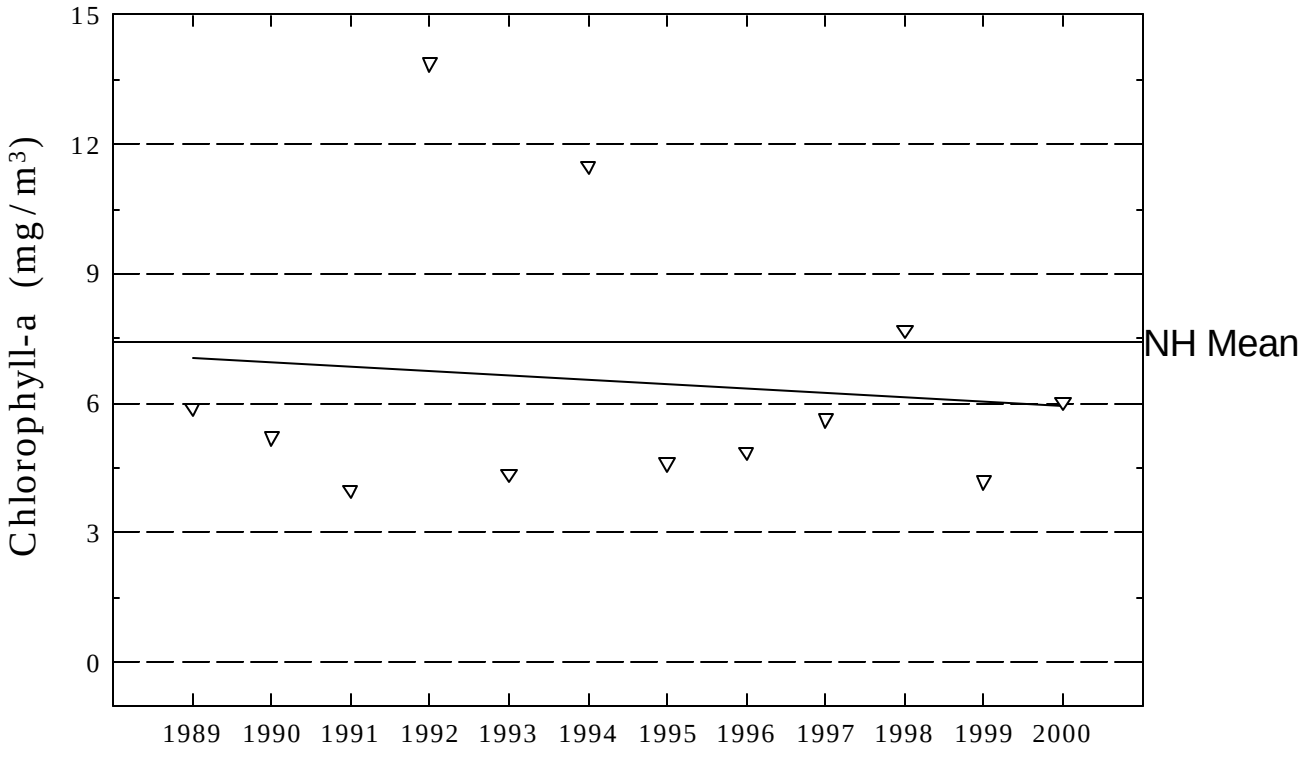
Freshwater Wetlands: A Guide to Common Indicator Plants of the Northeast. By Dennis Magee, Univ. of Massachusetts Press, 1981. (413) 545-0111, or www.umass.edu/umext/bookstore.html

Hills Pond

Figure 1. Monthly and Historical Chlorophyll-a Results



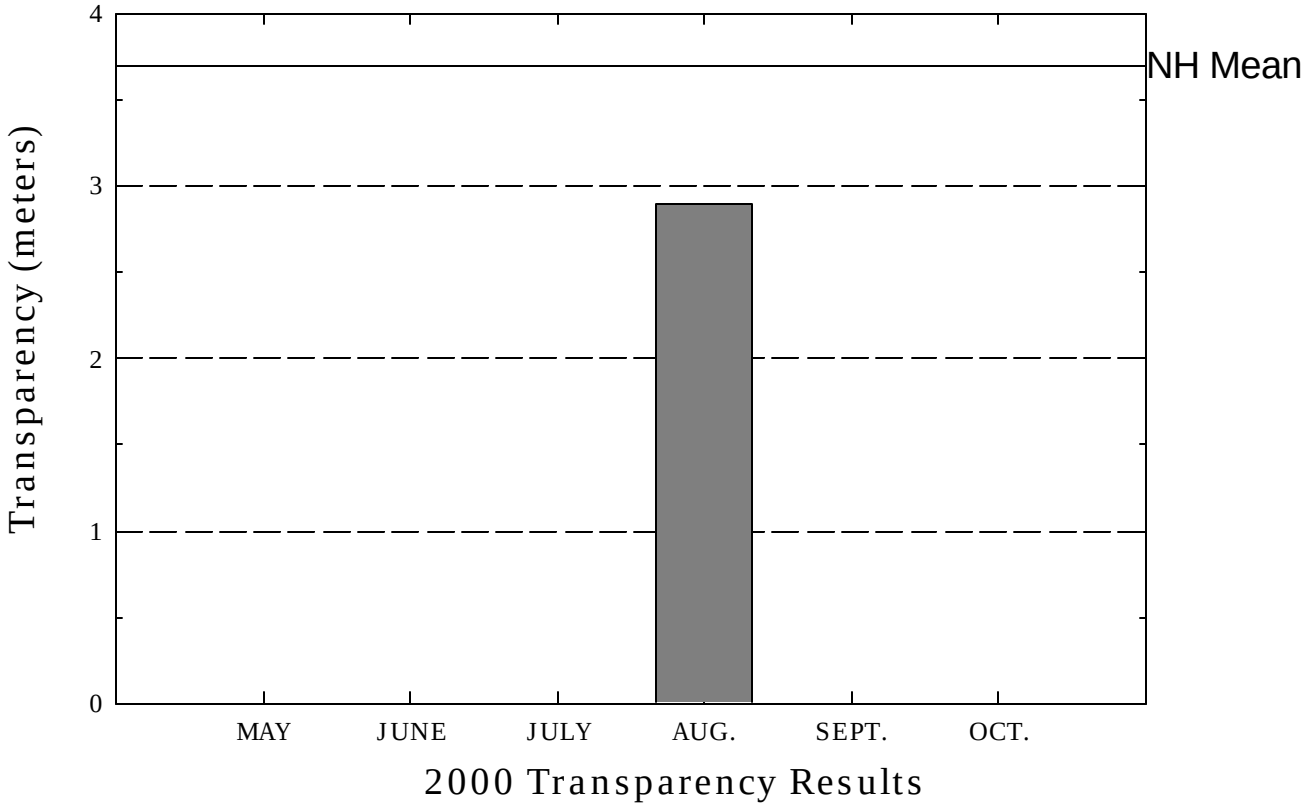
2000 Chlorophyll-a Results

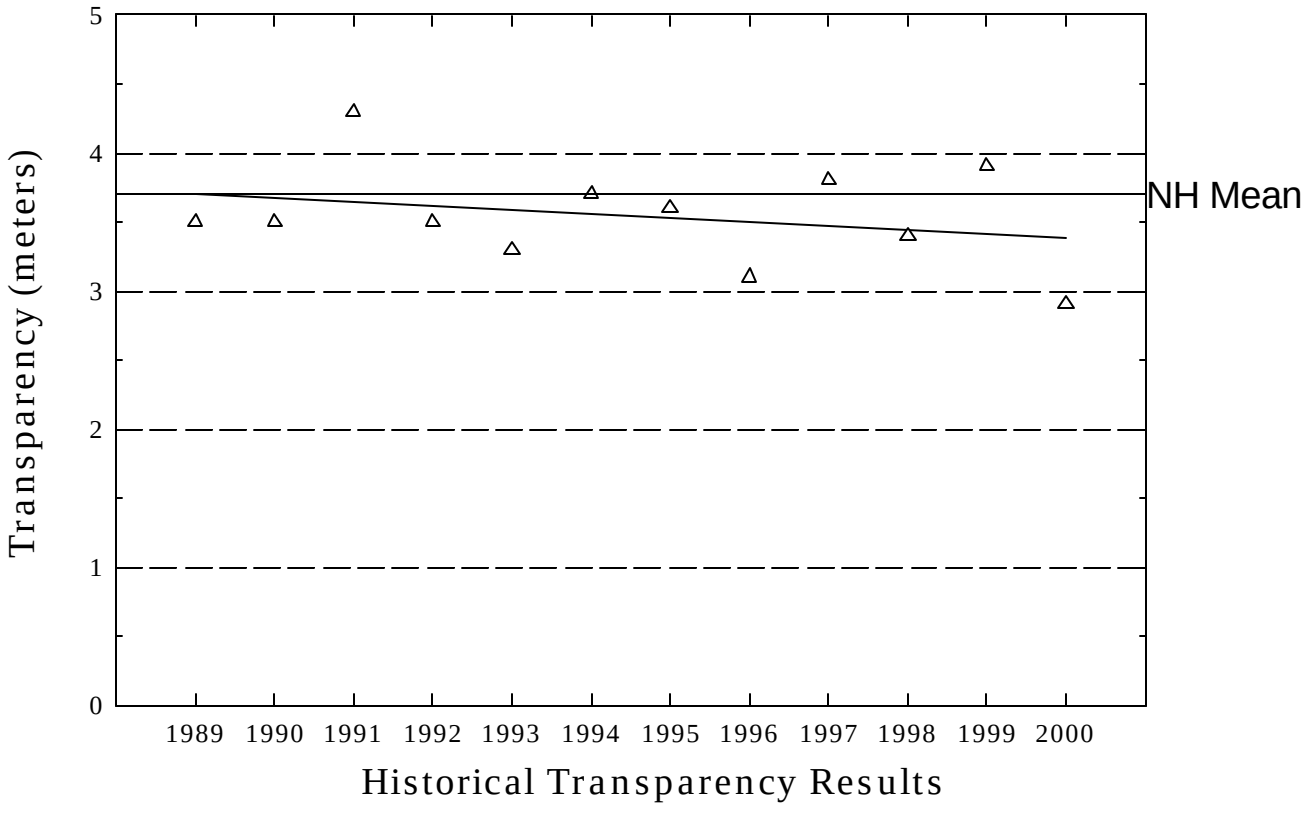


Historical Chlorophyll-a Results

Hills Pond

Figure 2. Monthly and Historical Transparency Results





Hills Pond

Figure 3. Monthly and Historical Total Phosphorus Data.

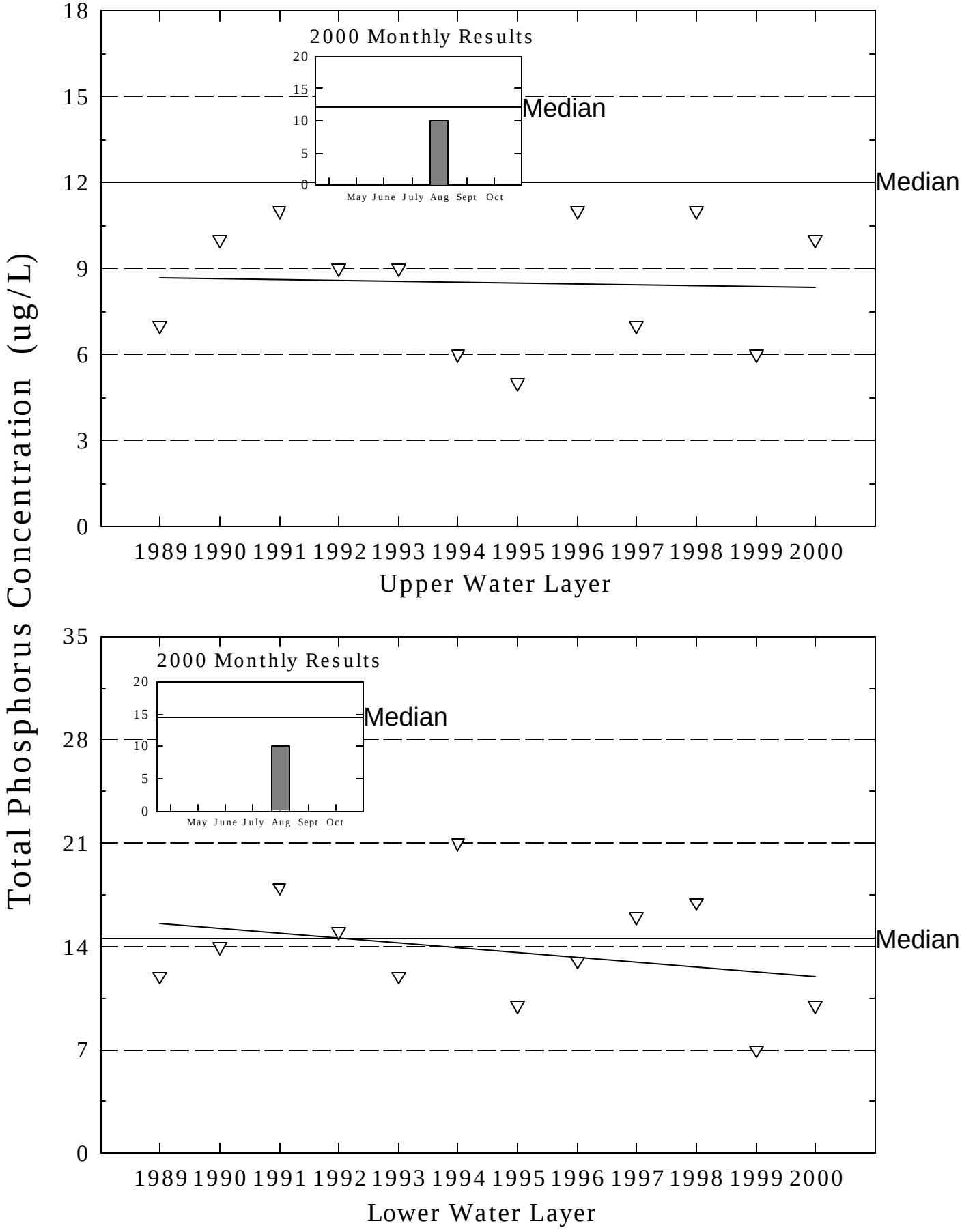


Table 1.

HILLS POND

ALTON

Chlorophyll-a results (mg/m^3) for current year and historical sampling periods.

Year	Minimum	Maximum	Mean
1989	5.90	5.90	5.90
1990	5.21	5.21	5.21
1991	3.98	3.98	3.98
1992	13.89	13.89	13.89
1993	4.36	4.36	4.36
1994	11.49	11.49	11.49
1995	4.62	4.62	4.62
1996	4.86	4.86	4.86
1997	5.64	5.64	5.64
1998	7.70	7.70	7.70
1999	4.19	4.19	4.19
2000	6.04	6.04	6.04

Table 2.

HILLS POND

ALTON

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
08/01/1989	TABELLARIA	53
	SYNURA	29
	RHIZOSOLENIA	
08/01/1990	SYNURA	63
	ASTERIONELLA	33
08/12/1991	ASTERIONELLA	32
	GLEOCYSTIS	17
	SYNURA	12
08/10/1992	SYNURA	62
	TABELLARIA	20
	CERATIUM	6
08/02/1993	ASTERIONELLA	46
	MICROCYSTIS	16
08/04/1994	CHRYSOSPHAERELLA	62
	TABELLARIA	14
	CERATIUM	7
07/31/1995	ASTERIONELLA	47
	CHRYSOSPHAERELLA	15
	MALLOMONAS	9
07/29/1996	DINOBRYON	22
	ASTERIONELLA	19
	TABELLARIA	16
08/03/1998	DINOBRYON	34
	SYNURA	33
	TABELLARIA	11
08/02/1999	CHRYSOSPHAERELLA	31
	TABELLARIA	26
	DINOBRYON	13
08/03/2000	RHIZOSOLENIA	35
	SYNURA	34
	DINOBRYON	12

Table 3.

HILLS POND

ALTON

Summary of current and historical Secchi Disk transparency results (in meters).

Year	Minimum	Maximum	Mean
1989	3.5	3.5	3.5
1990	3.5	3.5	3.5
1991	4.3	4.3	4.3
1992	3.5	3.5	3.5
1993	3.3	3.3	3.3
1994	3.7	3.7	3.7
1995	3.6	3.6	3.6
1996	3.1	3.1	3.1
1997	3.8	3.8	3.8
1998	3.4	3.4	3.4
1999	3.9	3.9	3.9
2000	2.9	2.9	2.9

Table 4.

HILLS POND

ALTON

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
EAST INLET UP				
	1996	6.33	6.33	6.33
	1997	6.59	6.59	6.59
	1998	6.70	6.70	6.70
	1999	6.72	6.72	6.72
	2000	6.57	6.57	6.57
EAST INLET				
	1989	6.79	6.79	6.79
	1990	6.83	6.83	6.83
	1991	6.70	6.70	6.70
	1992	6.58	6.58	6.58
	1993	6.84	6.84	6.84
	1994	6.74	6.74	6.74
	1995	6.70	6.70	6.70
	1996	6.19	6.19	6.19
	1997	6.57	6.57	6.57
	1998	6.74	6.74	6.74
	1999	6.82	6.82	6.82
	2000	6.62	6.62	6.62
EPILIMNION				
	1989	6.60	6.60	6.60
	1990	6.77	6.77	6.77
	1991	6.80	6.80	6.80
	1992	6.79	6.79	6.79
	1993	6.86	6.86	6.86
	1994	6.71	6.71	6.71
	1995	6.60	6.60	6.60

Table 4.

HILLS POND

ALTON

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
	1996	6.58	6.58	6.58
	1997	7.00	7.00	7.00
	1998	6.58	6.58	6.58
	1999	6.42	6.42	6.42
	2000	6.71	6.71	6.71
HYPOLIMNION				
	1989	5.95	5.95	5.95
	1990	6.14	6.14	6.14
	1991	6.10	6.10	6.10
	1992	6.00	6.00	6.00
	1993	6.09	6.09	6.09
	1994	5.89	5.89	5.89
	1995	6.00	6.00	6.00
	1996	5.65	5.65	5.65
	1997	5.81	5.81	5.81
	1998	5.84	5.84	5.84
	1999	6.04	6.04	6.04
	2000	5.94	5.94	5.94
METALIMNION				
	1989	5.96	5.96	5.96
	1991	6.20	6.20	6.20
	1992	6.05	6.05	6.05
	1993	6.07	6.07	6.07
	1994	5.97	5.97	5.97
	1995	6.11	6.11	6.11
	1996	5.67	5.67	5.67
	1997	5.94	5.94	5.94
	1998	5.81	5.81	5.81

Table 4.

HILLS POND

ALTON

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
	1999	6.23	6.23	6.23
	2000	5.99	5.99	5.99
NORTH INLET				
	1989	6.12	6.12	6.12
	1990	6.29	6.29	6.29
	1991	6.10	6.10	6.10
	1992	6.02	6.02	6.02
	1993	6.11	6.11	6.11
	1994	5.96	5.96	5.96
	1995	6.34	6.34	6.34
	1996	6.16	6.16	6.16
	1997	6.44	6.44	6.44
	1998	6.07	6.07	6.07
	1999	6.55	6.55	6.55
	2000	6.30	6.30	6.30
OUTLET				
	1997	6.13	6.13	6.13
SOUTH INLET				
	1989	6.12	6.12	6.12
	1991	5.90	5.90	5.90
	1992	6.08	6.08	6.08
	1993	6.08	6.08	6.08
	1994	6.08	6.08	6.08
	1995	6.01	6.01	6.01
	1996	6.18	6.18	6.18
	1998	6.37	6.37	6.37
	1999	6.22	6.22	6.22

Table 4.

HILLS POND

ALTON

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
	2000	6.30	6.30	6.30

Table 5.

HILLS POND

ALTON

Summary of current and historical Acid Neutralizing Capacity.
Values expressed in mg/L as CaCO .

Epilimnetic Values

Year	Minimum	Maximum	Mean
1989	3.80	3.80	3.80
1990	3.00	3.00	3.00
1991	4.10	4.10	4.10
1992	9.40	9.40	9.40
1993	3.60	3.60	3.60
1994	3.90	3.90	3.90
1995	4.30	4.30	4.30
1996	4.60	4.60	4.60
1997	4.00	4.00	4.00
1998	3.40	3.40	3.40
1999	4.30	4.30	4.30
2000	4.60	4.60	4.60

Table 6.

HILLS POND

ALTON

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
EAST INLET UP				
	1996	29.2	29.2	29.2
	1997	30.7	30.7	30.7
	1998	26.6	26.6	26.6
	1999	35.9	35.9	35.9
	2000	29.8	29.8	29.8
EAST INLET				
	1989	28.9	28.9	28.9
	1990	27.0	27.0	27.0
	1991	28.8	28.8	28.8
	1992	27.4	27.4	27.4
	1993	29.8	29.8	29.8
	1994	33.3	33.3	33.3
	1995	31.7	31.7	31.7
	1996	27.4	27.4	27.4
	1997	31.3	31.3	31.3
	1998	28.7	28.7	28.7
	1999	35.4	35.4	35.4
	2000	29.7	29.7	29.7
EPILIMNION				
	1989	25.5	25.5	25.5
	1990	25.2	25.2	25.2
	1991	26.2	26.2	26.2
	1992	29.5	29.5	29.5
	1993	27.3	27.3	27.3
	1994	29.9	29.9	29.9
	1995	30.2	30.2	30.2

Table 6.

HILLS POND

ALTON

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1996	30.2	30.2	30.2
	1997	29.4	29.4	29.4
	1998	26.2	26.2	26.2
	1999	34.2	34.2	34.2
	2000	31.1	31.1	31.1
HYPOLIMNION				
	1989	30.9	30.9	30.9
	1990	26.6	26.6	26.6
	1991	29.6	29.6	29.6
	1992	32.3	32.3	32.3
	1993	28.9	28.9	28.9
	1994	34.1	34.1	34.1
	1995	32.7	32.7	32.7
	1996	37.7	37.7	37.7
	1997	32.0	32.0	32.0
	1998	31.2	31.2	31.2
	1999	36.6	36.6	36.6
	2000	33.2	33.2	33.2
METALIMNION				
	1989	27.3	27.3	27.3
	1991	26.1	26.1	26.1
	1992	29.5	29.5	29.5
	1993	28.0	28.0	28.0
	1994	30.5	30.5	30.5
	1995	31.5	31.5	31.5
	1996	31.7	31.7	31.7
	1997	29.7	29.7	29.7

Table 6.

HILLS POND

ALTON

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1998	31.5	31.5	31.5
	1999	33.7	33.7	33.7
	2000	32.9	32.9	32.9
NORTH INLET				
	1989	28.3	28.3	28.3
	1990	35.2	35.2	35.2
	1991	42.0	42.0	42.0
	1992	25.3	25.3	25.3
	1993	31.2	31.2	31.2
	1994	32.1	32.1	32.1
	1995	32.7	32.7	32.7
	1996	28.6	28.6	28.6
	1997	30.8	30.8	30.8
	1998	28.7	28.7	28.7
	1999	36.8	36.8	36.8
	2000	22.8	22.8	22.8
OUTLET				
	1997	25.7	25.7	25.7
SOUTH INLET				
	1989	27.8	27.8	27.8
	1991	38.1	38.1	38.1
	1992	23.7	23.7	23.7
	1993	24.5	24.5	24.5
	1994	28.2	28.2	28.2
	1995	27.9	27.9	27.9
	1996	23.2	23.2	23.2
	1998	23.5	23.5	23.5

Table 6.

HILLS POND

ALTON

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1999	138.6	138.6	138.6
	2000	30.2	30.2	30.2

Table 8.

HILLS POND

ALTON

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
EAST INLET UP				
	1996	20	20	20
	1997	41	41	41
	1998	23	23	23
	1999	21	21	21
	2000	27	27	27
EAST INLET				
	1989	29	29	29
	1990	32	32	32
	1991	29	29	29
	1992	91	91	91
	1993	28	28	28
	1994	40	40	40
	1995	24	24	24
	1997	20	20	20
	1998	20	20	20
	1999	25	25	25
	2000	17	17	17
EPILIMNION				
	1989	7	7	7
	1990	10	10	10
	1991	11	11	11
	1992	9	9	9
	1993	9	9	9
	1994	6	6	6
	1995	5	5	5
	1996	11	11	11

Table 8.

HILLS POND

ALTON

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
	1997	7	7	7
	1998	11	11	11
	1999	6	6	6
	2000	10	10	10
HYPOLIMNION				
	1989	12	12	12
	1990	14	14	14
	1991	18	18	18
	1992	15	15	15
	1993	12	12	12
	1994	21	21	21
	1995	10	10	10
	1996	13	13	13
	1997	16	16	16
	1998	17	17	17
	1999	7	7	7
	2000	10	10	10
METALIMNION				
	1989	10	10	10
	1991	14	14	14
	1992	14	14	14
	1993	10	10	10
	1994	14	14	14
	1995	14	14	14
	1996	10	10	10
	1997	10	10	10
	1998	9	9	9

Table 8.

HILLS POND

ALTON

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
	1999	4	4	4
	2000	8	8	8
NORTH INLET				
	1989	19	19	19
	1990	44	44	44
	1991	25	25	25
	1992	18	18	18
	1993	23	23	23
	1994	34	34	34
	1995	22	22	22
	1996	14	14	14
	1997	19	19	19
	1998	26	26	26
	1999	18	18	18
	2000	10	10	10
OUTLET				
	1997	24	24	24
SOUTH INLET				
	1989	22	22	22
	1991	29	29	29
	1992	18	18	18
	1993	24	24	24
	1994	52	52	52
	1995	39	39	39
	1996	21	21	21
	1998	43	43	43
	1999	24	24	24

Table 8.

HILLS POND

ALTON

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
	2000	9	9	9

Table 9.

HILLS POND

ALTON

Current year dissolved oxygen and temperature data.

Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
		August 3, 2000	
0.1	22.0	8.0	91.4
1.0	21.2	7.9	89.0
2.0	20.8	7.7	85.6
3.0	20.3	7.1	78.7
4.0	19.0	5.0	53.8
5.0	14.4	2.6	25.8
6.0	11.8	3.1	28.4
7.0	10.1	3.6	31.9
8.0	9.0	2.7	23.7
9.0	8.5	1.4	12.2
10.0	8.3	0.5	4.2
11.0	8.4	0.4	3.3

Table 10.

HILLS POND

ALTON

Historic Hypolimnetic dissolved oxygen and temperature data.

Date	Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
August 1, 1989	12.0	5.8	1.6	12.0
August 1, 1990	9.0	6.5	2.8	22.7
August 12, 1991	10.5	7.0	0.5	4.1
August 10, 1992	11.0	5.1	0.3	2.3
August 2, 1993	10.0	6.0	1.2	10.0
August 4, 1994	11.0	6.6	0.5	4.0
July 31, 1995	12.0	7.0	0.3	2.0
July 29, 1996	12.0	5.6	0.2	1.0
August 4, 1997	12.0	8.0	0.3	3.0
August 3, 1998	11.0	6.5	0.1	1.0
August 2, 1999	11.0	7.8	0.3	7.0
August 3, 2000	11.0	8.4	0.4	3.3

Table 11.

HILLS POND
ALTON

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
EAST INLET UP				
	1997	0.2	0.2	0.2
	1998	0.2	0.2	0.2
	1999	0.4	0.4	0.4
	2000	0.3	0.3	0.3
EAST INLET				
	1997	0.2	0.2	0.2
	1998	0.2	0.2	0.2
	1999	0.4	0.4	0.4
	2000	0.3	0.3	0.3
EPILIMNION				
	1997	0.4	0.4	0.4
	1998	0.3	0.3	0.3
	1999	0.3	0.3	0.3
	2000	0.4	0.4	0.4
HYPOLIMNION				
	1997	2.7	2.7	2.7
	1998	4.0	4.0	4.0
	1999	5.0	5.0	5.0
	2000	0.9	0.9	0.9
METALIMNION				
	1997	0.5	0.5	0.5
	1998	0.5	0.5	0.5
	1999	0.9	0.9	0.9
	2000	0.4	0.4	0.4
NORTH INLET				
	1997	1.5	1.5	1.5

Table 11.

HILLS POND

ALTON

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
	1998	1.2	1.2	1.2
	1999	1.8	1.8	1.8
	2000	0.2	0.2	0.2
OUTLET				
	1997	0.6	0.6	0.6
SOUTH INLET				
	1998	0.4	0.4	0.4
	1999	0.9	0.9	0.9
	2000	0.2	0.2	0.2

Table 12.

HILLS POND

ALTON

Summary of current year bacteria sampling.
Results in counts per 100ml.

Location	Date	E. Coli See Note Below
BEACH		
	August 3	5

NOTE: "<" means "less than" and ">" means "greater than"